Cognitive Dysfunction After Acute Lacunar Infarct

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Vascular dementia and vascular cognitive impairment have attracted more attention recently due to their association with increased risk of death and institutionalization. The purpose of the present study was to detect and identify the characteristics of cognitive impairments during the early stage of lacunar stroke. The subjects consisted of 23 consecutive first-ever acute lacunar infarction patients who were admitted to the Department of Neurology, Kaohsiung Municipal Hsiao-Kang Hospital, Taiwan, from November 2001 to October 2002. The National Institutes of Health Stroke Scale and Cognitive Abilities Screening Instrument (CASI) were used to evaluate stroke severity and cognitive function, and assessments were performed by a neurologist and psychologist, within 10 days of stroke onset. Of the 23 patients, 21 (91.3%) had CASI scores below their respective cutoff values and all patients had cognitive impairment in at least one cognitive domain in CASI. There were no significant correlations between CASI abnormality (below the cutoff value) and patient age, education, or the interval from stroke onset. Recent memory impairment was the most often impaired cognitive domain on CASI (19 patients, 82.6%). There were significant correlations between recent memory and "attention or concentration"(correlation coefficient, 0.52; $p < 0.05$), and "abstraction and judgment" (correlation coefficient, 0.44; $p < 0.05$). The correlations between recent memory and other domains were not significant. It was concluded that cognitive impairment after acute lacunar infarct is quite common and recent memory is the most often impaired cognitive domain. This may have been caused by the location of the specific lesion as well as by the impairment in "attention or concentration" or "abstraction and judgment".

Key Words: lacunar infarcts, CASI, cognitive function, recent memory
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With prolonged life expectancy and the resultant increase in the elderly population, vascular dementia and vascular cognitive impairment have increasingly attracted more attention due to their association with an increased risk of death and institutionalization [1]. Of stroke survivors, 25% have dementia after stroke [2–4], and the development of incident dementia in this group remains up to nine times greater than in the age-matched population for at least 5 years after stroke [5].

Early detection of cognitive dysfunction in stroke patients is important because it is hoped that preventive strategies can be instituted in the early phase of the illness. Although lacunar infarct has been suggested as a major stroke entity associated with vascular dementia [6], few studies have examined the cognitive function of patients with acute lacunar infarction. The purpose of the present study was to detect and identify the characteristics of cognitive impairment in the early stage after lacunar stroke.

Subjects and Methods

The subjects consisted of consecutive patients (> 45 years old) with a first-ever acute lacunar infarct who were admitted

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to the Department of Neurology, Kaohsiung Municipal Hsiao-Kang Hospital, between November 2001 and October 2002.

Stroke is defined by the World Health Organization (WHO) as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function lasting more than 24 hours (unless interrupted by surgery or death) with no apparent cause other than of vascular origin" [7]. Lacunar infarct was diagnosed clinically by a neurologist according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification of acute ischemic stroke [8–10], supported by investigations such as computed tomography (CT) showing lesions of less than 1.5 cm in diameter. Patients with other psychiatric or neurologic disorders (e.g. head injury or Parkinson's disease) that could lead to cognitive impairment were excluded. Clinically, first-ever strokes were defined as events occurring in patients without a history of stroke. Stroke history was based on all available information from patients, families, and hospital records.

The National Institutes of Health Stroke Scale (NIHSS) [11] and Cognitive Abilities Screening Instrument (CASI) [12,13] were used to evaluate stroke severity and cognitive function, respectively. Assessments were performed by a neurologist and psychologist, respectively, within 10 days of stroke onset. CASI is a globally recognized method of screening cognitive function and has been used in a number of international studies of dementia. It includes items similar or identical to those used in the Mini-Mental State Examination, the Modified Mini-Mental State Test [14], and the Hasegawa Dementia Screening Scale [15], and it can usually be administered within 30 minutes. The CASI total scores range from 0 (worst) to 100 (best). Items in CASI can be divided into nine cognitive domains: long-term memory, short-term memory, attention, concentration, orientation, abstraction and judgment, language abilities, visual construction, and category fluency. For detailed information of the cutoff value in the CASI Chinese version (CASI C-2.0), see Lin et al [16].

RESULTS

A total of 23 subjects (13 men and 10 women) with complete data were recruited. Their average age was 71.3 ± 8.7 years and average educational level was 2.7 ± 3.0 years of school (Table 1). The mean NIHSS score at admission was 4.7 ± 2.9 and CASI total scores ranged from 22 to 75. The average interval between stroke onset and CASI evaluation was 4.0 ± 2.3 days.

Table 1. Means and ranges of various clinical characteristics

	Mean ± SD	Range
Male:Female		13:10
Age (yr)	71.3 ± 8.7	48–87
Education (yr)	2.7 ± 3.0	0–8
NIHSS score	4.7 ± 2.9	0–11
CASI scores	47.1 ± 17.4	22–75
Days from stroke onset*	4.0 ± 2.3	1–9

*Time from stroke onset to the performance of CASI. SD = standard deviation; NIHSS = National Institutes of Health Stroke Scale; CASI = Cognitive Abilities Screening Instrument.

CT scan at admission showed that lacunar infarction at the corona radiata was most common (n = 10), followed by no visible abnormality (n = 9), multiple lacunar infarcts (n = 2), thalamic lacunar (n = 1), and pontine lacunar (n = 1) (Table 2).

The correlation between CASI total score and the interval from stroke onset was not significant (Table 3). There was significant negative correlation between CASI total score and patient age ($p < 0.05$). The correlation between CASI total score and education level was marginal ($p < 0.1$). Therefore, the cutoff value for CASI total score was adjusted for each patient according to their respective age and education level [16,17]. After adjustment, a patient's CASI abnormality was not significantly correlated with age, education, or the interval from stroke onset.

Twenty-one patients (91.3%) had CASI scores below their respective cutoff values and all patients had at least one cognitive domain abnormality. The performance of the 23 patients in each cognitive domain is shown in Table 4. Recent memory impairment was most common (n = 19), followed by disorientation (13), abstraction and judgment, concentration and drawing, language, remote memory and fluency, and attention. Among the 23 patients, 16 (69.6%) had impairment in either attention or concentration.

Table 2. Brain computed tomography findings

Lesion location	n (%)
Corona radiata	10 (43.5)
Negative finding	9 (39.1)
Multiple lacunar infarction	2 (8.7)
Thalamus	1 (4.3)
Pons	1 (4.3)
Total	23 (100.0)

Table 3. Correlation of clinical characteristics with Cognitive Abilities Screening Instrument (CASI) total score and CASI abnormality

	CASI total score		CASI abnormality	
	Pearson's correlation coefficient	*p*	Pearson's correlation coefficient	*p*
Days from stroke onset	–0.2627	0.2259	–0.0060	0.9785
Age	–0.5182	0.0113	–0.1338	0.5427
Education	0.3622	0.0894	0.1196	0.5867

Table 4. Cognitive Abilities Screening Instrument (CASI) performance and performance below cutoff values in each cognitive domain

	Mean ± SD	Maximum score in CASI domain	Abnormality, *n* (%)
Recent memory	2.24 ± 2.26	12	19 (82.6)
Orientation	9.30 ± 6.25	18	13 (56.5)
Abstraction and judgment	4.78 ± 2.02	12	11 (47.8)
Concentration	2.67 ± 2.71	10	10 (43.5)
Drawing	4.17 ± 3.33	10	10 (43.5)
Language	5.50 ± 2.72	10	9 (39.1)
Fluency	3.43 ± 2.44	10	8 (34.8)
Remote memory	7.09 ± 3.06	10	8 (34.8)
Attention	4.70 ± 2.16	8	7 (30.4)

SD = standard deviation.

There was significant correlation between recent memory and "attention or concentration" (correlation coefficient, 0.52; $p < 0.05$), and abstraction and judgment (correlation coefficient, 0.44; $p < 0.05$). The correlation between recent memory and other domains was not significant.

Discussion

The present study demonstrates that 91.3% (21/23) of acute lacunar infarct patients have CASI scores below their respective cutoff values and all patients have cognitive impairment in at least one cognitive domain on CASI. Lacunar infarct has generally been considered a clinically benign process, which coincided with an average NIHSS score of 4.7 (range, 0–11) in the present study (Table 1). Therefore, the high incidence of CASI abnormality was not expected and is worth discussion.

The CASI cutoff values used in the present study may have been too high and make most patients fall below the "normal range". Nonetheless, the cutoff values used have been validated in earlier studies and have high sensitivity and specificity in the aged with 0 years of education (49/50; sensitivity, 0.83; specificity, 0.85), 1–5 years of education (67/68; sensitivity, 0.83; specificity, 0.91), and at least 6 years of education (79/80; sensitivity, 0.89; specificity, 0.90) [13,14]. It is worth noting that there were no significant correlations between CASI abnormality and patient age or education or the interval from stroke onset. This suggests that the influence of age, education, and the interval from stroke onset was limited in the present study.

Pre-morbid cognitive dysfunction may have played a role, because dementia is seen in similar age groups as stroke patients and comorbidity is a well-known possibility. However, as the prevalence of dementia and mild cognitive impairment is, at most, around 10–15% in the elderly [18], it is difficult to explain the high incidence of abnormalities in CASI total scores and recent memory subscore (91.3% and 82.6%, respectively) in the present study.

Because the brain is generally considered an integrated distributed functional network, acute dysfunction in one part of it may induce simultaneous derangement in several cognitive functions [19]. The high rate of cognitive abnormality in the present study, 56.5% of patients at an average of 4 days from stroke onset, are compatible with the 41% of disoriented patients 7–10 days after stroke found by

Desmond et al [20].

It is interesting to note that recent memory is the most often impaired cognitive domain. Because there is significant correlation between recent memory and attention/concentration, it is likely that attentional/concentrational deficit (seen in 69.6% of patients) may lead to recent memory impairment in some patients. However, factors such as location of lacunar lesion should also be taken into account. Brain CT scan findings in the present study as well as in previous reports have shown that lacunar infarcts are mainly located in deep-seated areas such as the basal ganglia, thalamus, and surrounding internal capsule and corona radiata, many of which are known to be important in memory processes. This may explain why recent memory impairment occurs predominantly.

Desmond et al identified delayed improvement in cognitive function in about 10% of stroke patients 3–15 months after stroke [21]. Another study has also indicated that more than 30% of subjects with mild cognitive impairment between 0 and 6 months after stroke improved and could be classified as cognitively intact by 12–18 months [22]. Therefore, although high percentages of patients suffer from cognitive dysfunction in the acute stage, it can be expected that only some of them will have vascular cognitive impairment or dementia if no further stroke insult occurs [23].

In conclusion, although the number of cases in the present study is limited, cognitive impairment was quite common in our acute lacunar infarct patients. Recent memory was the most often impaired cognitive domain. This may have been caused by the location of the stroke lesion as well as by deficits in "attention or concentration" or "abstraction and judgment".

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急性陷窩型腦梗塞的認知功能障礙

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血管性失智症 (**vascular dementia**) 與血管性認知功能缺損 (**vascular cognitive impairment**) 近來由於造成死亡與入住養護機構的風險不斷升高，因此引起了更多的關注。而本研究的目的即著重於發現並釐清在早期陷窩型腦梗塞病人所引起的認知功能障礙。本研究分析了在高雄市立小港醫院神經科自西元 **2001** 年 **11** 月至 **2002** 年 **10** 月間診斷為臨床上初次罹患急性陷窩型腦梗塞的患者，並有完整神經心理學測驗之資料者。我們分別以 **NIHSS scale** 來評估中風的嚴重度，及以認知能力篩檢工具 (**CASI**) 來評估認知功能。這些檢查是分別由神經科醫師與臨床心理師於中風發生後 **10** 天內所執行。這項研究發現共 **23** 位急性陷窩型腦梗塞的患者中，**91.3%** (**21**人) 受測之 **CASI** 總分低於應具備的水平分數 (**cutoff value**)。而每一位病人至少都有一項 **CASI** 分項測驗分數異常。在所有的分項中，近期記憶是最普遍有缺損，共佔了 **82.6%**。**CASI** 測驗總分異常 (低於臨界值) 與病人的年齡、教育程度、及施做測驗時與中風發生的間隔時間長短並無明顯相關。這項研究發現認知功能缺損在急性陷窩型腦梗塞病人是很常見的。在所有的分項中，近期記憶是最普遍有缺損的認知功能。而這些認知功能的缺損可能與腦梗塞位置有關；或是因為病人合併有注意力或集中力之缺損，抑或是抽象思考及判斷力之缺損有關。

關鍵詞：急性陷窩型腦梗塞，認知能力篩檢工具，認知功能，近期記憶

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